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(54) **WIRELESS INDUCEMEMT SYSTEM AND AUTO DRIVING APPARATUS FOR DRIVING VEHICLE AND METHOD OF DRIVING THE SAME**

(71) Applicant: **Electronics and Telecommunications Research Institute**, Daejeon (KR)

(72) Inventor: **Seok-Jin Lee**, Daegu (KR)

(73) Assignee: **ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE**, Daejeon (KR)

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USPC 342/357.06; 701/301, 2
See application file for complete search history.

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Primary Examiner — Helal A Algahaim
Assistant Examiner — Mahmoud Ismail

(57) **ABSTRACT**

A wireless inducement system and an auto driving apparatus for driving a vehicle and a method of driving the same are provided. The wireless inducement system includes an implanted road positioning signaler, an auto driving apparatus, and smart roadside equipment. The implanted road positioning signaler is installed in a lane and transmits a reference location wireless signal including information about location coordinates and an electric wave sending time. The auto driving apparatus grasps a location using the received reference location wireless signal and performs auto driving, and the smart roadside equipment transmits situation information about an adjacent region of the vehicle to the auto driving apparatus.
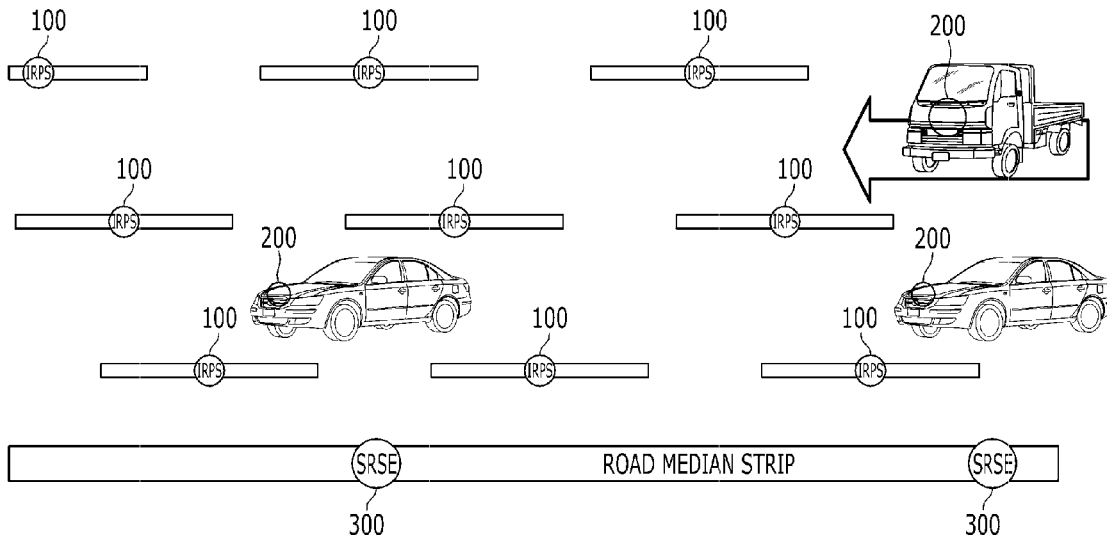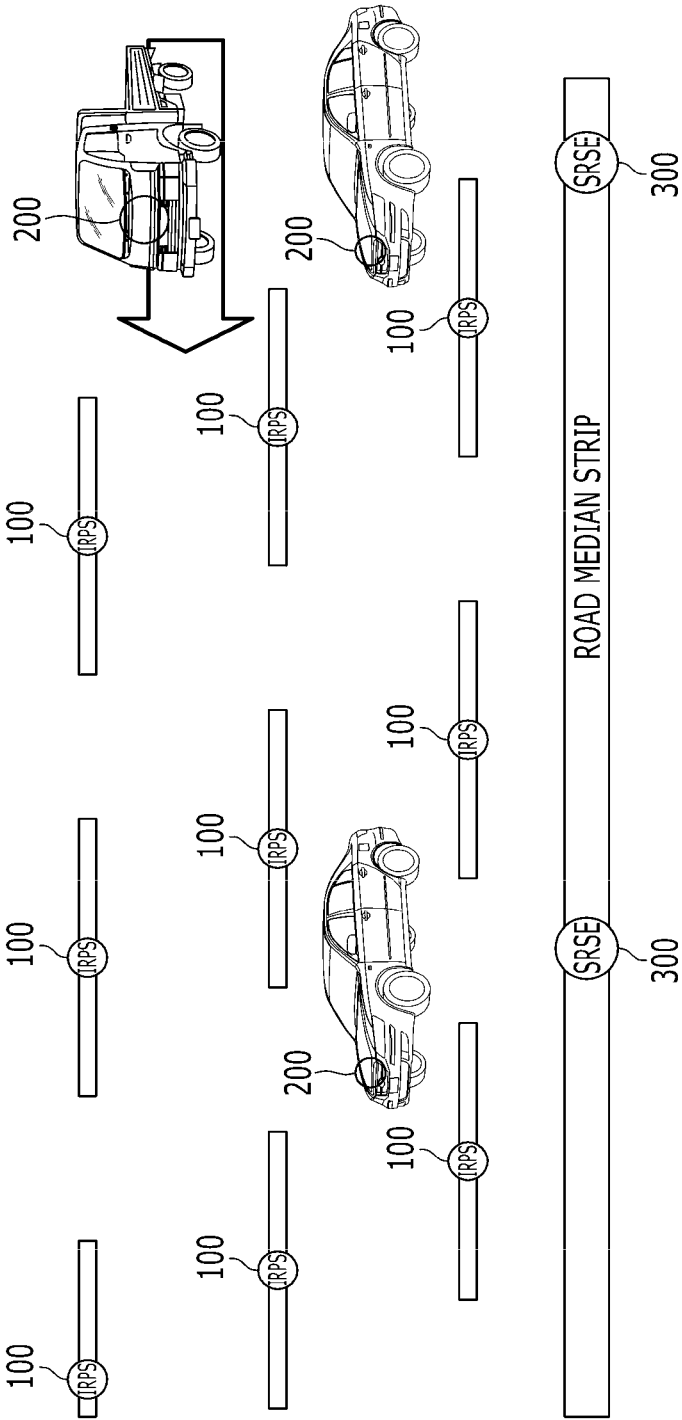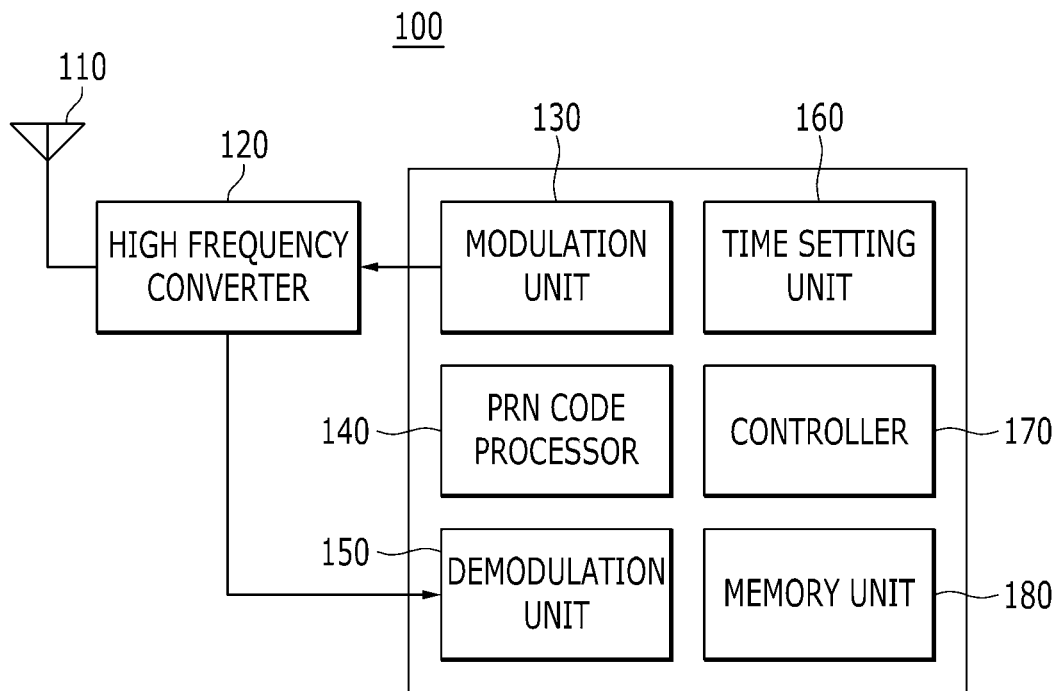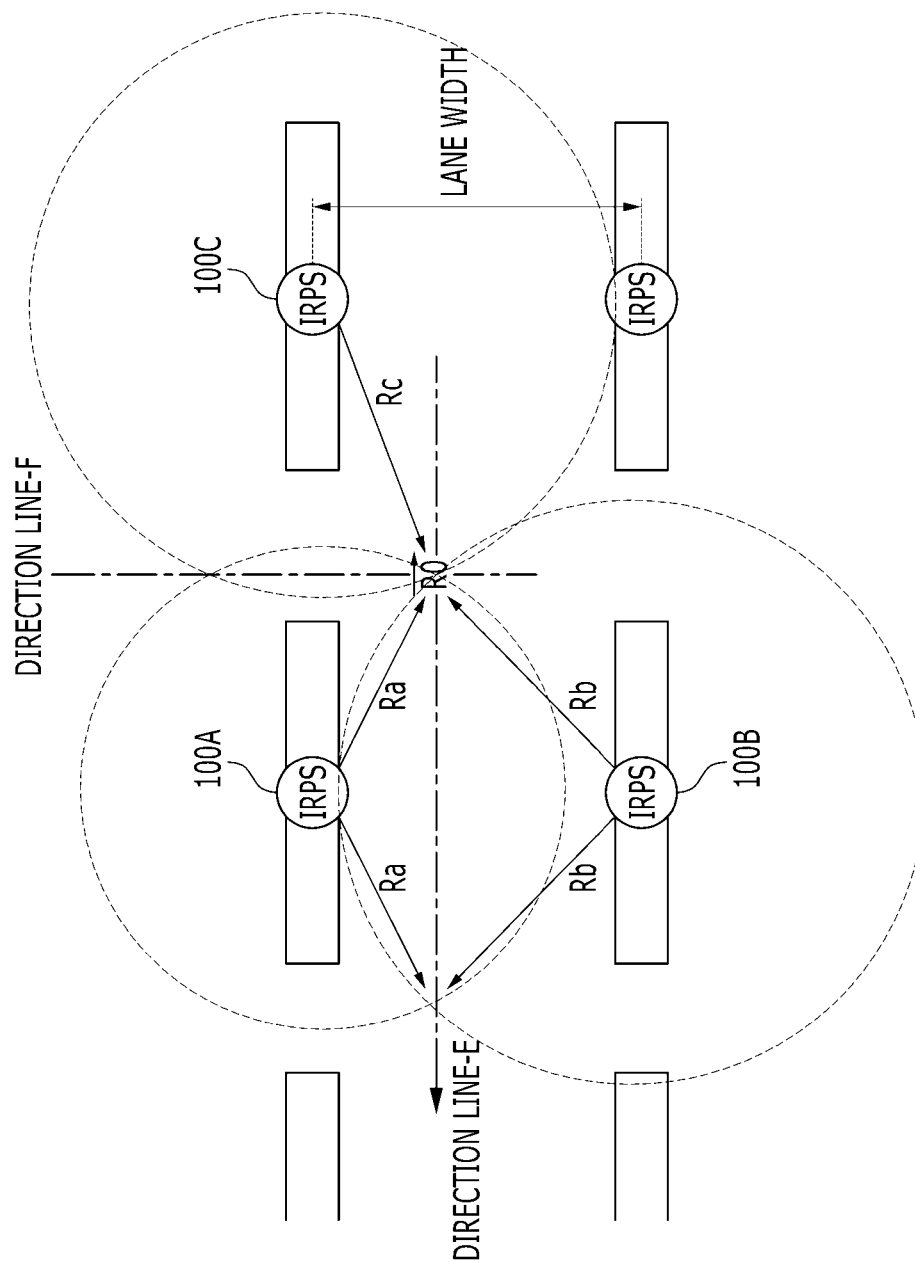
18 Claims, 7 Drawing Sheets

FIG.1

ROAD MEDIAN STRIP

SRSE 300

SRSE 300

IRPS 100

IRPS 100

IRPS 100

IRPS 100

IRPS 100

IRPS 100

IRPS 100

IRPS 100

IRPS 100

IRPS 100

IRPS 100

IRPS 100

200

200

200

FIG.2

FIG.3

FIG.4

FIG.5

FIG.6

300

320

PROCESSOR
MEMORY

340

360

RF MODULE

FIG.7

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┌─────────────────────────────────────────┐
│   RECEIVE REFERENCE LOCATION WIRELESS    │──S710
│        SIGNAL FROM IRPS 100              │
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│  CALCULATE RECEIVED SIGNAL ARRIVAL TIME AND │──S720
│   IRPS LOCATION COORDINATES OF IRPS 100  │
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│     RECEIVE ADJACENT REGION SITUATION    │──S730
│       INFORMATION FROM SRSE 300          │
└─────────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────────┐
│  USE CALCULATED LOCATION AND ADJACENT REGION │──S740
│  SITUATION INFORMATION FOR AUTO DRIVING  │
└─────────────────────────────────────────┘
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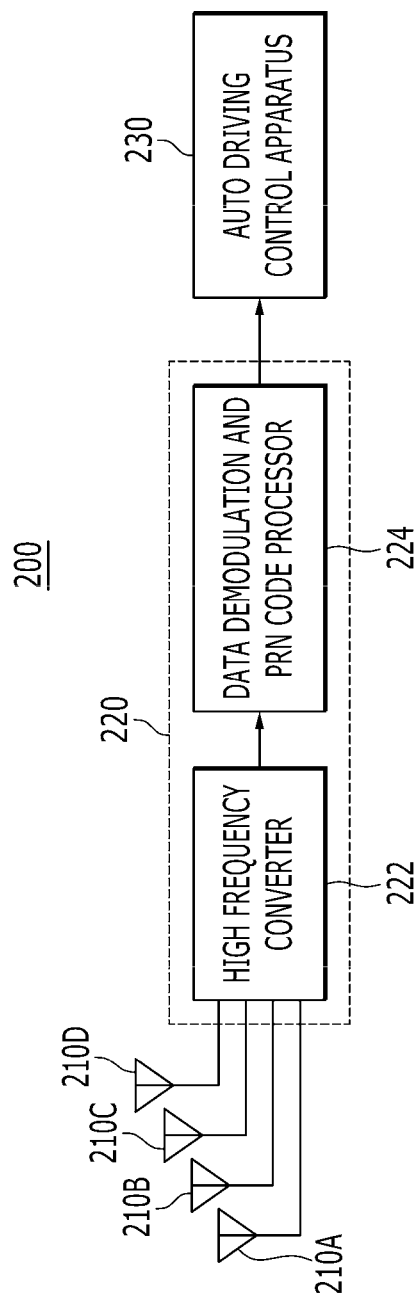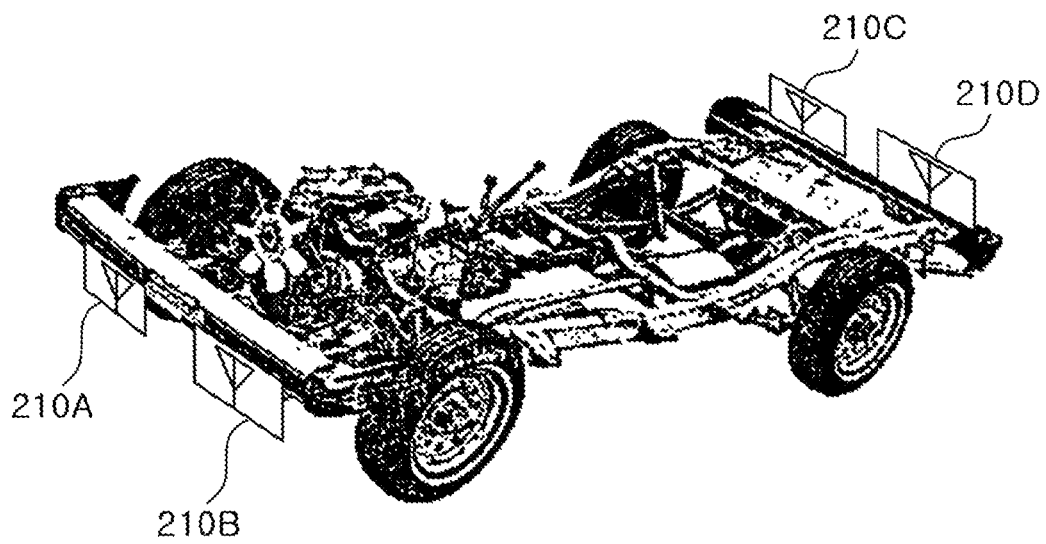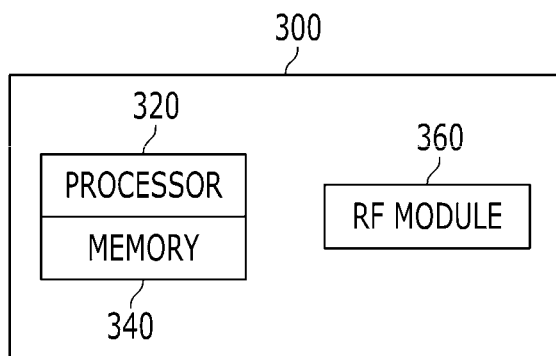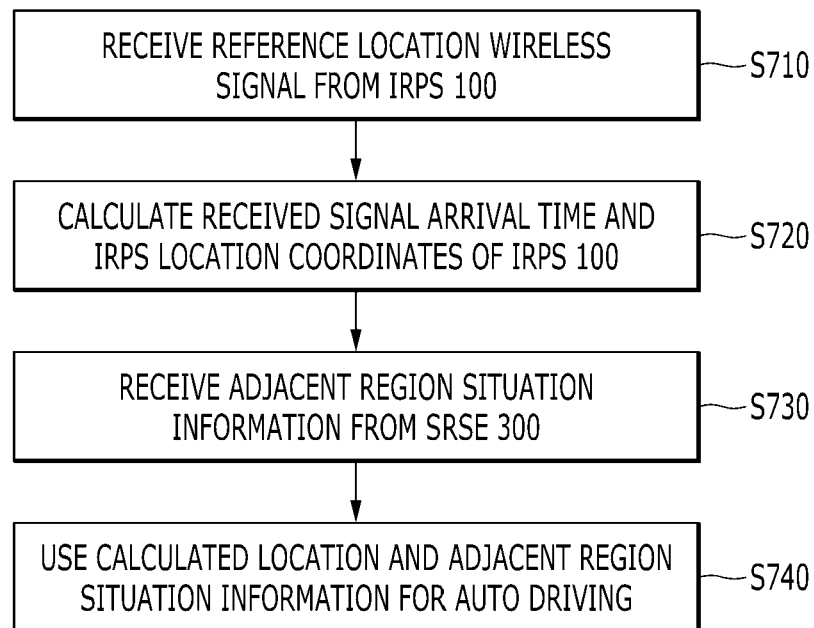
WIRELESS INDUCEMEMT SYSTEM AND AUTO DRIVING APPARATUS FOR DRIVING VEHICLE AND METHOD OF DRIVING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority to and the benefit of Korean Patent Application No. 10-2012-0107398 and No. 10-2013-0113602 filed in the Korean Intellectual Property Office on Sep. 26, 2012 and Sep. 25, 2013, respectively, the entire contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

(a) Field of the Invention

The present invention relates to a wireless inducement system and an auto driving apparatus for driving a vehicle, and a method of driving the same.

(b) Description of the Related Art

Currently, much research on vehicles having an unmanned driving function that automatically drive to a destination without a driver's manipulation is being performed. According to an existing method, an auto driving vehicle analyzes data that is obtained through various sensors such as a satellite navigation device, an inertial navigation device, radar, an ultrasonic wave measuring device, a laser scanner, and a camera that are mounted in the vehicle with an internal computer, grasps a form and an obstacle of a road based on analyzed information, and generates driving information.

For example, an auto driving vehicle determines a lane with a camera instead of a driver's naked eye, and acquires a distance of an adjacent obstacle using radar. Because such a method determines an obstacle that is positioned on a driving path based on a sensor recognition ability, a sensor recognition range should be wide and reliability with regard to resolution and accuracy should be high. Further, in order to reflect a high speed driving situation of the vehicle, there is a problem that information that is acquired from a sensor should be processed at a high speed.

There is a drawback that in an inertial navigation device, an error is continuously accumulated, and a satellite navigation device has a restriction in space and time.

For an unmanned driving function, a long distance situation of a driving direction should be known, and an adjacent obstacle situation should be immediately known. However, the above conventional auto driving vehicle determines the situation and performs auto driving itself, and road equipment does not actively intervene.

SUMMARY OF THE INVENTION

The present invention has been made in an effort to provide a wireless inducement system and an auto driving apparatus for driving a vehicle, and a method of driving the same, having advantages of driving the vehicle with high stability and accuracy.

An exemplary embodiment of the present invention provides a wireless inducement system. The wireless inducement system includes: a plurality of implanted road positioning signalers (IRPS) that are installed in a lane and that transmit a reference location wireless signal including information about location coordinates and an electric wave sending time; an auto driving apparatus that receives a reference location wireless signal from each of the plurality of IRPSes and that grasps a location and performs auto driving using the

received reference location wireless signal; and smart roadside equipment (SRSE) that manages the plurality of IRPSes and that transmits situation information about an adjacent region of a vehicle in which the auto driving apparatus is mounted to the auto driving apparatus.

The plurality of IRPSes may include a first IRPS that is installed in a first lane, a second IRPS that is installed in a second lane that is parallel and adjacent to the first lane, and a third IRPS that is installed in a third lane that is adjacent to the first lane and the second lane.

The auto driving apparatus may calculate a distance of the vehicle from the center of the lane using a reference location wireless signal that is received from the first IRPS and a reference location wireless signal that is received from the second IRPS.

The auto driving apparatus may perform auto driving using the situation information.

The auto driving apparatus may include a data demodulation and pseudo random noise (PRN) code processor that compares a PRN code that is previously set therein and the reference location wireless signal, and that extracts a received signal arrival time and an intrinsic number of the plurality of IRPSES using code correlation, and an auto driving control apparatus that calculates the location using the intrinsic number and the received signal arrival time.

The auto driving apparatus may transmit speed, location, and advancing direction information of the vehicle to the SRSE.

The SRSE may manage synchronization, a sleep mode, and a wakeup mode of the plurality of IRPSes.

The plurality of IRPSes each may generate the reference location wireless signal using an intrinsic PRN code.

Another embodiment of the present invention provides an auto driving apparatus that is mounted in a vehicle and that automatically drives without a driver's manipulation. The auto driving apparatus includes: a positioning information receiving apparatus that receives reference location wireless signals from each of at least three IRPSes and that extracts a received signal arrival time and an intrinsic number of the IRPS from the IRPS; and an auto driving control apparatus that calculates a location of the vehicle using the intrinsic number and the received signal arrival time and that performs auto driving based on the calculated location of the vehicle, wherein the at least three IRPSes each include first and second IRPSes that are installed in a lane and that are installed in adjacent and parallel lanes.

The auto driving apparatus may calculate a distance of the vehicle from the center of the lane using a reference location wireless signal that is received from the first IRPS and a reference location wireless signal that is received from the second IRPS.

The positioning information receiving apparatus may include a high frequency converter that receives the reference location wireless signal and that converts the reference location wireless signal to a low frequency signal, and a data demodulation and PRN code processor that compares a PRN code that is previously set therein and the reference location wireless signal and that extracts the intrinsic number and the received signal arrival time using a code correlation.

The auto driving apparatus may transmit the calculated location of the vehicle and speed and direction information of the vehicle to the SRSE.

The auto driving apparatus may receive situation information about an adjacent region of the vehicle from the SRSE and perform auto driving using the situation information.

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The auto driving apparatus may further include a plurality of antennas that are installed at a plurality of points, respectively, of the vehicle.

Yet another embodiment of the present invention provides a method of driving an auto driving apparatus that is mounted in a vehicle to automatically drive. The method includes: receiving a first reference location wireless signal from a first IRPS that is installed in a first lane; receiving a second reference location wireless signal from a second IRPS that is installed in a second lane that is parallel and adjacent to the first lane; receiving a third reference location wireless signal from a third IRPS that is installed in a third lane adjacent to the first and second lanes; calculating a location of the vehicle using the first, second, and third reference location wireless signals; and performing auto driving of the vehicle based on the calculated location of the vehicle.

The method may further include calculating a distance from a center point that is positioned between the first lane and the second lane to the vehicle using the first reference location wireless signal and the second reference location wireless signal.

The method may further include setting a direction of the vehicle to the center point using the distance.

The first, second, and third reference location wireless signals may include location coordinates and an electric wave sending time of the first, second, and third IRPSes, respectively.

The method may further include: transmitting the calculated location of the vehicle to an SRSE; receiving situation information about an adjacent region of the vehicle from the SRSE; and performing the auto driving using the situation information.

According to an exemplary embodiment of the present invention, by performing auto driving using a signal that is received from a wireless apparatus that is installed in a lane, auto driving with high stability and accuracy can be performed.

According to an exemplary embodiment of the present invention, because situation information of an adjacent region can be grasped through smart roadside equipment, a vehicle can know a state of a peripheral vehicle very quickly without directly viewing a motion of the peripheral vehicle. Because an advancing direction situation of the vehicle can be grasped from the SRSE even at a curved line segment in which a visual field is not secured, safety driving can be performed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagram illustrating a wireless inducement system according to an exemplary embodiment of the present invention.

FIG. 2 is a block diagram illustrating a configuration of the IRPS 100 according to an exemplary embodiment of the present invention.

FIG. 3 is a diagram illustrating a method of measuring a vehicle's location in a wireless inducement system according to an exemplary embodiment of the present invention.

FIG. 4 is a block diagram illustrating a configuration of the auto driving apparatus 200 according to an exemplary embodiment of the present invention.

FIG. 5 is a perspective view illustrating that a plurality of antennas 210A-210D of the auto driving apparatus 200 are installed on a vehicle.

FIG. 6 is a block diagram illustrating a configuration of the SRSE 300 according to an exemplary embodiment of the present invention.

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FIG. 7 is a flowchart illustrating an entire operation of the auto driving apparatus 200 according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

In the following detailed description, only certain exemplary embodiments of the present invention have been shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive. Like reference numerals designate like elements throughout the specification.

In addition, in the entire specification, unless explicitly described to the contrary, the word "comprise" and variations such as "comprises" or "comprising" will be understood to imply the inclusion of stated elements but not the exclusion of any other elements.

Hereinafter, a wireless inducement system for driving a vehicle according to an exemplary embodiment of the present invention will be described in detail with reference to the drawings.

FIG. 1 is a diagram illustrating a wireless inducement system according to an exemplary embodiment of the present invention.

As shown in FIG. 1, the wireless inducement system according to an exemplary embodiment of the present invention includes an implanted road positioning signaler (IRPS) 100, an auto driving apparatus 200, and smart roadside equipment (SRSE) 300.

The IRPS 100 is installed on a road lane and performs a function of a global positioning system (GPS) satellite. The IRPS 100 transmits a reference location wireless signal to a vehicle driving to an adjacent region, and the auto driving apparatus 200 that is installed in the vehicle grasps a location of the vehicle using a reference location wireless signal that is received from the IRPS 100. The IRPS 100 is managed by the SRSE 300 that is installed at the outside of a road. That is, the IRPS 100 adjusts synchronization by the SRSE 300 and adjusts a sleep mode and a wakeup mode.

A plurality of IRPSes 100 that are positioned at a short range may form a group, and all IRPSes 100 belonging to the group may be operated with time synchronization and may send an electric wave signal of the same frequency band. A plurality of IRPSes 100 belonging to the same group each modulate data using an intrinsic pseudo random noise (PRN) code, and each IRPS is distinguished by the intrinsic PRN code. Data that is modulated by the PRN code includes location coordinates (hereinafter referred to as an "IRPS location coordinates") where the IRPS 100 is positioned, and a time (hereinafter referred to as an "electric wave sending time") that a reference location wireless signal is transmitted.

FIG. 2 is a block diagram illustrating a configuration of the IRPS 100 according to an exemplary embodiment of the present invention.

As shown in FIG. 2, the IRPS 100 according to an exemplary embodiment of the present invention includes an antenna 110, a high frequency converter 120, a modulation unit 130, a PRN code processor 140, a demodulation unit 150, a time setting unit 160, a controller 170, and a memory unit 180.

The antenna 110 receives or transmits a wireless signal, and the high frequency converter 120 converts a received high

frequency signal to a low frequency signal or converts a low frequency signal to a high frequency signal to transmit it.

The modulation unit **130** modulates data to transmit.

In order to distinguish each IRPS **100**, the PRN code processor **140** generates an intrinsic PRN code. A method of generating and processing the intrinsic PRN code may be easily known by a person of common skill in the art, and therefore a detailed description thereof will be omitted.

The demodulation unit **150** demodulates received data, and a demodulation method may be differently set according to a modulation method.

The time setting unit **160** generates time information using a synchronization signal that is received in the SRSE **300**.

The controller **170** controls an entire operation of the IRPS **100**, and the memory unit **180** stores information (e.g., IRPS location coordinates) about each IRPS **100**.

The auto driving apparatus **200** is mounted in a vehicle, grasps the vehicle's location using a reference location wireless signal that is received from a plurality of IRPSes **100**, and controls auto driving of the vehicle based on the grasped location.

FIG. **3** is a diagram illustrating a method of measuring a vehicle's location in a wireless inducement system according to an exemplary embodiment of the present invention.

In FIG. **3**, a location thereof in which the auto driving apparatus **200** is to measure is represented by $\vec{R}_0$. It is assumed that the auto driving apparatus **200** receives a reference location wireless signal from IRPSes **100A**, **100B**, and **100C** that are installed in each of at least three lanes. The IRPS **100A** and the IRPS **100B** each are positioned at adjacent and parallel lanes.

The auto driving apparatus **200** may generate three circular areas that are shown in FIG. **3** using a reference location wireless signal that is received from each of the IRPSes **100A**, **100B**, and **100C**, and may determine a point at which the three circular areas intersect to be a location $\vec{R}_0$ thereof. In other words, the auto driving apparatus **200** extracts an arrival time of the received signal and IRPS location coordinates at a reference location wireless signal that is received from each of the IRPSes **100A**, **100B**, and **100C**, and calculates a location $\vec{R}_0$ thereof using the arrival time and the IRPS location coordinates.

Radius displays Ra, Rb, and Rc of circular areas that are indicated by dotted lines in FIG. **3** indicate an arrival time of a synchronized reference location wireless signal, and the arrival time is calculated through an electric wave sending time of the received reference location wireless signal. The IRPSes **100A**, **100B**, and **100C** each have fixed locations on a road, and have intrinsic numbers and IRPS location coordinates. A method in which the auto driving apparatus **200** calculates a location $\vec{R}_0$ thereof is represented by Equation 1.

$$|\vec{R}_a - \vec{R}_0| = C(\Delta t_a + \Delta t_0)$$

$$|\vec{R}_b - \vec{R}_0| = C(\Delta t_b + \Delta t_0)$$

$$|\vec{R}_c - \vec{R}_0| = C(\Delta t_c + \Delta t_0) \qquad \text{(Equation 1)}$$

In Equation 1, $\vec{R}_a$, $\vec{R}_b$, $\vec{R}_c$ are IRPS location coordinates of the IRPSES **100A**, **100B**, and **100C**, respectively, that are installed on a road, and $\vec{R}_a$, $\vec{R}_b$, $\vec{R}_c$ are included in a reference location wireless signal that the auto driving apparatus **200** receives. Δt_b is an electric wave arrival time of a reference location wireless signal that the auto driving apparatus **200** receives, and Δt_0 represents an error of a clock that is included

in the auto driving apparatus **200**. C represents a speed of an electric wave, i.e., the speed of light. Location coordinates of each of the IRPSes **100A**, **100B**, and **100C** are known values, and therefore the auto driving apparatus **200** obtains a location $\vec{R}_0$ thereof using Equation 2 regardless of Δt_0, which is an error.

The adjacent IRPS **100A** and IRPS **100B** that are positioned at parallel lanes maintain a distance of a lane width, and may thus have a meaning of a pair and can increase use thereof using the pair. The auto driving apparatus **200** calculates a direction line E that is shown in FIG. **3** using a reference location wireless signal that it receives from the IRPS **100A** and a reference location wireless signal that it receives from the IRPS **100B**, and recognizes a distance to the center of a lane through the calculated direction line E. That is, when a vehicle passes through between the IRPS **100A** and the IRPS **100B**, the auto driving apparatus **200** that is mounted in the vehicle calculates an arrival time of reference location wireless signals that are received from each of two IRPSes **100A** and **100B** and calculates a distance to the lane center through a difference between the two calculated arrival times. The auto driving apparatus **200** may know how much a location thereof is shifted from the lane center through the calculated distance to a lane center, and may automatically set a direction in toward the lane center using the shifted location.

A detailed configuration of the auto driving apparatus **200** that measures a vehicle's location in this way will be described with reference to FIG. **4**.

FIG. **4** is a block diagram illustrating a configuration of the auto driving apparatus **200** according to an exemplary embodiment of the present invention.

As shown in FIG. **4**, the auto driving apparatus **200** according to an exemplary embodiment of the present invention includes a plurality of antennas **210A-210D**, a positioning information receiving apparatus **220**, and an auto driving control apparatus **230**.

The plurality of antennas **210A-210D** may be installed at the front and the rear of a vehicle. FIG. **5** is a perspective view illustrating that a plurality of antennas **210A-210D** of the auto driving apparatus **200** are installed on a vehicle. As shown in FIG. **5**, the antenna **210A** is installed at the right front of the vehicle, and the antenna **210B** is installed at the left front side of the vehicle. The antenna **210C** is installed at the right rear of the vehicle, and the antenna **210D** is installed at the left rear of the vehicle. In this method, in order to acquire a variety at front and rear space information and left and right space information of the vehicle, the auto driving apparatus **200** according to an exemplary embodiment of the present invention disposes a plurality of antennas **210A-210D** at several locations of the vehicle. In this method, by acquiring space information of several locations through the plurality of antennas **210A-210D**, a location and a direction of the vehicle can be more accurately grasped.

The positioning information receiving apparatus **220** includes a high frequency converter **222** and a data demodulation and PRN code processor **224**.

The high frequency converter **222** is connected to the data demodulation and PRN code processor **224**, and converts a received high frequency signal to a low frequency signal or converts a low frequency signal to a high frequency signal to transmit it.

The data demodulation and PRN code processor **224** compares a PRN code that is previously set therein and a reference location wireless signal that is received from the IRPS **100**, and extracts a received signal arrival time value and an intrinsic number of the IRPS **100** using code correlation. The data

demodulation and PRN code processor **224** transmits the calculated intrinsic number and the received signal arrival time to the auto driving control apparatus **230**.

The auto driving control apparatus **230** calculates a location thereof using the received intrinsic number and received signal arrival time. The auto driving control apparatus **230** may grasp that the received reference location wireless signal is received from which IRPS **100** through the received intrinsic number, thereby knowing an IRPS location coordinates of the IRPS **100**. The auto driving control apparatus **230** calculates a location thereof, as represented in Equation 1, using location coordinates and a received signal arrival time.

The auto driving control apparatus **230** provides location information, a driving speed, and direction information (direction line E) thereof by wireless to the SRSE **300**, and the auto driving control apparatus **230** receives situation information of an adjacent region from the SRSE **300** and uses the situation information for auto driving.

The auto driving control apparatus **230** sends an intrinsic number and a received signal arrival time to the SRSE **300** without directly calculating a location thereof. In this case, the SRSE **300** calculates a vehicle's location using the intrinsic number and the received signal arrival time, and again transmits the location to the auto driving control apparatus **230**. The auto driving control apparatus **230** uses the received location thereof for auto driving.

Such an auto driving control apparatus **230** may be embodied through a smart networked vehicle controller (SNVC).

As shown in FIG. **1**, a plurality of SRSEes **300** are installed at the road side or a median strip.

The SRSE **300** supports time synchronization of each group to which the IRPS **100** belongs, and performs a function of managing and monitoring the IRPS **100**.

The SRSE **300** collects information through communication with the auto driving apparatus **200** that is mounted in the vehicle. That is, the SRSE **300** collects speed, location coordinates, and advancing direction information of a vehicle driving in an adjacent region through wireless communication. The SRSE **300** provides a situation information service that transmits data that is collected in this way to a vehicle, i.e., the auto driving apparatus **200** of an adjacent region.

The SRSE **300** shares information through communication with another SRSE **300**, and exchanges various information through communication with a center control server (not shown in FIG. **1**).

FIG. **6** is a block diagram illustrating a configuration of the SRSE **300** according to an exemplary embodiment of the present invention.

As shown in FIG. **6**, the SRSE **300** according to an exemplary embodiment of the present invention includes a processor **320**, a memory **340**, and a radio frequency (RF) module **360**.

The processor **320** is formed to embody functions of the SRSE **300**. The memory **340** is connected to the processor **320** and stores various information that is related to operation of the processor **320**. The RF module **360** is connected to the processor **320** and transmits or receives a wireless signal. The SRSE **300** may have a single antenna or multiple antennas.

Hereinafter, a method in which the auto driving apparatus **200** grasps a location thereof and performs auto driving according to an exemplary embodiment of the present invention will be described with reference to FIG. **7**.

FIG. **7** is a flowchart illustrating an entire operation of the auto driving apparatus **200** according to an exemplary embodiment of the present invention.

First, the auto driving apparatus **200** receives a reference location wireless signal from the approaching IRPS **100**

(S710). In this case, the auto driving apparatus **200** receives reference location wireless signals from each of at least three IRPSes **100**. At least two of three IRPSes **100** may be positioned at adjacent and parallel lanes.

The auto driving apparatus **200** calculates a received signal arrival time and IRPS location coordinates of each IRPS **100** using the received reference location wireless signal (S720). In more detail, the auto driving apparatus **200** compares the received reference location wireless signal and a preset PRN code and compares a reference location wireless signal and extracts a received signal arrival time and an intrinsic number of each IRPS **100** using code correlation. The auto driving apparatus **200** obtains IRPS location coordinates of each IRPS **100** through the extracted intrinsic number.

The auto driving apparatus **200** calculates a location thereof, as represented in Equation 1, using the extracted intrinsic number and received signal arrival time. The auto driving apparatus **200** transmits situation information including the calculated location information thereof to the SRSE **300**. Here, the situation information may further include a driving speed and direction information of the auto driving apparatus **200**. The SRSE **300** transmits the received situation information to the adjacent auto driving apparatus **200**.

The auto driving apparatus **200** receives adjacent region situation information from the adjacent SRSE **300** (S730). Here, the adjacent region situation information is situation information that the SRSE **300** collects from the auto driving apparatus **200**, as described above.

Finally, the auto driving apparatus **200** uses a location that is calculated at step S720 and adjacent region situation information that is received at step S730 for auto driving (S740).

According to such an exemplary embodiment of the present invention, because location information of a vehicle can be grasped from an IRPS that is installed in a lane, the vehicle can dynamically set a virtual lane and perform auto driving to a destination. Particularly, when an exemplary embodiment of the present invention is applied to an express highway to drive according to a lane that is drawn on a road, a driver operates an auto driving apparatus when entering a tollgate, and the vehicle can accurately and reliably perform auto driving. Because the vehicle can grasp situation information of an adjacent region through the SRSE, the vehicle can know a state of peripheral vehicles very quickly without directly viewing a motion of the peripheral vehicles. Even at a curved line segment in which a visual field is not secured, an advancing direction situation of the vehicle can be grasped from the SRSE and thus safety driving can be performed.

While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A wireless inducement system, comprising:
   a plurality of implanted road positioning signalers (IRPSes) that each transmit a reference location wireless signal comprising information about location coordinates and an electric wave sending time of a corresponding one of the plurality of IRPSes, the plurality of IRPSes including a first IRPS that is installed in a first lane line extending in a first direction, a second IRPS that is installed in a second lane line that is parallel and adjacent to the first lane line, the second IRPS disposed opposite to the first IRPS in a second direction perpen-

dicular to the first direction, and a third IRPS that is installed in the first or second lane line;

an auto driving apparatus that receives three reference location wireless signals from the first, second, and third IRPSes, respectively, calculates a location of a vehicle based on arrival times of the three reference location wireless signals from the first, second, and third IRPSes, and performs auto driving using the received reference location wireless signals; and

smart roadside equipment (SRSE) that manages the plurality of IRPSes and that transmits situation information about an adjacent region of the vehicle in which the auto driving apparatus is mounted,

wherein the location of the vehicle is calculated using the following equations:

$$|\vec{R}_a - \vec{R}_0| = C(\Delta t_a + \Delta t_0)$$

$$|\vec{R}_b - \vec{R}_0| = C(\Delta t_b + \Delta t_0)$$

$$|\vec{R}_c - \vec{R}_0| = C(\Delta t_c + \Delta t_0),$$

wherein $\vec{R}_a$, $\vec{R}_b$, $\vec{R}_c$, and $\vec{R}_0$ are location coordinates of the first, second, and third IRPSes, and the auto driving apparatus, respectively, Δt_a, Δt_b, and Δt_c are the arrival times of the reference location wireless signals from the first, second, and third IRPSes, C is a speed of an electric wave, and Δt_0 is an error of a clock included in the auto driving apparatus, the arrival times each corresponding to a traveling time of a reference location wireless signal from a corresponding one of the first, second, and third IRPSes to the vehicle.

2. The wireless inducement system of claim **1**, wherein the auto driving apparatus receives a first reference location wireless signal from the first IRPS and a second reference location wireless signal from the second IRPS when the vehicle passes between the first and second IRPSes, calculates a first arrival time of the first reference location wireless signal and a second arrival time of the second reference location wireless signal, and calculates a distance of the vehicle from the center of a lane defined by the first and second lane lines using the first and second arrival times.

3. The wireless inducement system of claim **1**, wherein the auto driving apparatus performs the auto driving using the situation information.

4. The wireless inducement system of claim **1**, wherein the auto driving apparatus comprises:

a data demodulation and pseudo random noise (PRN) code processor that compares a PRN code that is previously set therein and a corresponding one of the received reference location wireless signals, and that extracts an arrival time of the compared reference location wireless signal and an intrinsic number of a corresponding one of the plurality of IRPSes using code correlation; and

an auto driving control apparatus that calculates the location of the vehicle using the intrinsic number and the arrival time.

5. The wireless inducement system of claim **1**, wherein the auto driving apparatus transmits speed, location, and advancing direction information of the vehicle to the SRSE.

6. The wireless inducement system of claim **1**, wherein the SRSE manages synchronization, a sleep mode, and a wakeup mode of the plurality of IRPSes.

7. The wireless inducement system of claim **1**, wherein the plurality of IRPSes each generate the reference location wireless signal using an intrinsic pseudo random noise (PRN) code.

8. An auto driving apparatus that is mounted in a vehicle and that automatically drives without a driver's manipulation, the auto driving apparatus comprising:

a positioning information receiving apparatus that receives three reference location wireless signals from three IRPSes, respectively, and that extracts arrival times of the reference location wireless signals and intrinsic numbers of the IRPSes; and

an auto driving control apparatus that calculates a location of the vehicle using the intrinsic numbers and the arrival times of the reference location wireless signals, and that performs auto driving based on the calculated location of the vehicle,

wherein the three IRPSes comprise first and second IRPSes installed in first and second lane lines, respectively, the first lane line extending in a first direction, the second lane line being adjacent and parallel to the first lane line, the second IRPS disposed opposite to the first IRPS in a second direction perpendicular to the first direction, the three IRPSes further comprising a third IRPS that is installed in the first or second lane line,

wherein the location of the vehicle is calculated using the following equations:

$$|\vec{R}_a - \vec{R}_0| = C(\Delta t_a + \Delta t_0)$$

$$|\vec{R}_b - \vec{R}_0| = C(\Delta t_b + \Delta t_0)$$

$$|\vec{R}_c - \vec{R}_0| = C(\Delta t_c + \Delta t_0),$$

wherein $\vec{R}_a$, $\vec{R}_b$, $\vec{R}_c$, and $\vec{R}_0$ are location coordinates of the first, second, and third IRPSes, and the auto driving apparatus, respectively, Δt_a, Δt_b, and Δt_c are the arrival times of the reference location wireless signals from the first, second, and third IRPSes, C is a speed of an electric wave, and Δt_0 is an error of a clock included in the auto driving apparatus, the arrival times each corresponding to a traveling time of a reference location wireless signal from a corresponding one of the first, second, and third IRPSes to the vehicle.

9. The auto driving apparatus of claim **8**, wherein the auto driving apparatus receives a first reference location wireless signal from the first IRPS and a second reference location wireless signal from the second IRPS when the vehicle passes between the first and second IRPSes, calculates a first arrival time of the first reference location wireless signal and a second arrival time of the second reference location wireless signal, and calculates a distance of the vehicle from the center of a lane defined by the first and second lane lines using the first and second arrival times.

10. The auto driving apparatus of claim **8**, wherein the positioning information receiving apparatus comprises:

a high frequency converter that receives the reference location wireless signals and that converts each of the reference location wireless signals to a low frequency signal; and

a data demodulation and pseudo random noise (PRN) code processor that compares a PRN code that is previously set therein and a corresponding one of the reference location wireless signals and that extracts an intrinsic number of a corresponding one of the IRPSes and an arrival time of the compared reference location wireless signal using code correlation.

11. The auto driving apparatus of claim **8**, wherein the auto driving apparatus transmits the calculated location of the vehicle and speed and direction information of the vehicle to the SRSE.

12. The auto driving apparatus of claim **11**, wherein the auto driving apparatus receives situation information about an adjacent region of the vehicle from the SRSE and performs the auto driving using the situation information.

13. The auto driving apparatus of claim **8**, further comprising a plurality of antennas that are installed at a plurality of points, respectively, of the vehicle.

14. A method of driving an auto driving apparatus that is mounted in a vehicle to automatically drive, the method comprising:

receiving a first reference location wireless signal from a first implanted road positioning signaler (IRPS) that is installed in a first lane line extending in a first direction;

receiving a second reference location wireless signal from a second IRPS that is installed in a second lane line that is parallel and adjacent to the first lane line, the second IRPS disposed opposite to the first IRPS in a second direction perpendicular to the first direction;

receiving a third reference location wireless signal from a third IRPS that is installed in the first or second lane line;

calculating a location of the vehicle based on arrival times of the first, second, and third reference location wireless signals; and

performing auto driving of the vehicle based on the calculated location of the vehicle,

wherein the location of the vehicle is calculated using the following equations:

$$|\vec{R}_a - \vec{R}_0| = C(\Delta t_a + \Delta t_0)$$

$$|\vec{R}_b - \vec{R}_0| = C(\Delta t_b + \Delta t_0)$$

$$|\vec{R}_c - \vec{R}_0| = C(\Delta t_c + \Delta t_0),$$

wherein $\vec{R}_a$, $\vec{R}_b$, $\vec{R}_c$, and $\vec{R}_0$ are location coordinates of the first, second, and third IRPSes, and the auto driving apparatus, respectively, Δt_a, Δt_b, and Δt_c are the arrival times of the reference location wireless signals from the first, second, and third IRPSes, C is a speed of an electric wave, and Δt_0 is an error of a clock included in the auto driving apparatus, the arrival times each corresponding to a traveling time of a reference location wireless signal from a corresponding one of the first, second, and third IRPSes to the vehicle.

15. The method of claim **14**, wherein the first reference location wireless signal from the first IRPS and a second reference location wireless signal from the second IRPS are received when the vehicle passes between the first and second IRPSes, the method further comprising:

calculating a first arrival time of the first reference location wireless signal and a second arrival time of the second reference location wireless signal; and

calculating a distance from a center point that is positioned between the first lane line and the second lane line to the vehicle using the first and second arrival times.

16. The method of claim **15**, further comprising setting a direction of the vehicle to the center point using the distance.

17. The method of claim **14**, wherein the first, second, and third reference location wireless signals comprise electric wave sending times and location coordinates of the first, second, and third IRPSes, respectively.

18. The method of claim **14**, further comprising:

transmitting the calculated location of the vehicle to smart roadside equipment (SRSE);

receiving situation information about an adjacent region of the vehicle from the SRSE; and

performing the auto driving using the situation information.

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